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QUALITY ASSURANCE / QUALITY CONTROL PLAN

ENVIRONMENTAL RESTORATION PROGRAM

Rocky Flats Plant

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Rockwell International
Aerospace Operations
Rocky Flats Plant
Golden, Colorado

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TABLE OF CONTENTS

TABLES

FIGURES

QUALITY ASSURANCE/QUALITY CONTROL PLAN

1 INTRODUCTION

Multi-media monitoring activities at Rocky Flats Plant are part of the Department of Energy's (DOE) Environmental Restoration Program (the ER Program was formerly called the Comprehensive Environmental Assessment and Response Program (CEARP) This Quality Assurance/Quality Control (QA/QC) Plan is one component of the monitoring plans for Rocky Flats Plant The monitoring plans consists of five parts Sampling Plan, Technical Data Management Plan, Health and Safety Plan, Quality Assurance/Quality Control Plan, and Standard Operating Procedures

ER Program sampling and analysis activities will be implemented using procedures to assure that the precision, accuracy, completeness, and representativeness of data are known and documented At a minimum, this will include adherence to the ER Program Quality Assurance/Quality Control Plan, and may include preparation of written Quality Assurance/Quality Control Plans covering each aspect of the project performed

This Quality Assurance/Quality Control Plan presents the organization, objectives, functional activities, and specific quality assurance and quality control activities associated with the ER Program The Quality Assurance/Quality Control Plan is designed to achieve specific data quality goals for ER Program sampling and analysis activities at the Rocky Flats Plant

2. ER PROGRAM PROJECT ORGANIZATION AND RESPONSIBILITY

Project organization and responsibility are divided among DOE, Los Alamos National Laboratory, and Rockwell International as described below Los Alamos National Laboratory has the primary responsibility to implement the ER Program under the guidance of DOE-Albuquerque Operations Office However, operational responsibilities have been assigned to Rockwell International at Rocky Flats Plant The DOE-Rocky Flats Area Office is responsible for the function of the Rocky Flats Plant Because of this responsibility, the DOE-Rocky Flats Area Office will provide additional guidance to its contractor, Rockwell International, in implementation of the ER Program

Project organization is shown in Figure 2 1 The responsibilities of the various personnel can be divided into operational, laboratory, and quality assurance responsibilities, as follows

2 1 OPERATIONAL RESPONSIBILITIES

Assistant Secretary for the Environment The DOE Assistant Secretary for the Environment appoints Headquarters investigation boards and establishes the scope of Headquarters investigations (DOE Order 5484 1) DOE-wide Environmental Surveys and Audits originate from the Assistant Secretary

Environmental Surveys and Audits Headquarters Environmental Survey Teams have been directed to conduct one-time environmental surveys and sampling of DOE facilities These surveys are independent of ER Program activities at

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The Administrative Record Staff

Rocky Flats plant, but data from survey team sampling will be utilized in the ER Program characterization of Rocky Flats Plant A Headquarters environmental survey team visited the Rocky Flats Plant site in 1986 The results of the survey will be used as an internal management tool by the Secretary and Undersecretary of DOE

Audits are a function of the Office of the Assistant Secretary for the Environment Audit teams provide quality control for the implementation of environmental monitoring at DOE facilities Although independent of the ER Program, audit teams complement ER Program activities by providing additional quality assurance

DOE-Albuquerque Operations Office Environmental Programs Branch The DOE-Albuquerque Operations Office, Environmental Programs Branch, is responsible for overseeing all environmental programs within DOE-Albuquerque Operations and conducting special assessments such as the ER Program

DOE-Rocky Flats Area Office The DOE Rocky Flats Area Office is responsible for the missions of the Rocky Flats Plant, including environmental protection The DOE Rocky Flats Area Office oversees the integration of Rocky Flats Plant resources with ER Program activities at Rocky Flats Plant

Rockwell International Rockwell International, as prime contractor to DOE, provides support to DOE in accomplishing the mission of Rocky Flats Plant, including environmental protection Rockwell International will implement the ER Program at Rocky Flats Plant

Los Alamos National Laboratory Los Alamos National Laboratory manages the ER program, providing direction, oversight and review

2.2. ANALYTICAL LABORATORY RESPONSIBILITIES

Analytical laboratory services will be arranged by Rockwell International The Rockwell laboratory facilities may be used or contracts may be made with commercial laboratories Participation of a commercial laboratory is contingent upon acceptance of the laboratory's quality assurance program

2.3 QA RESPONSIBILITY

Quality assurance responsibilities are to monitor and review the procedures used to perform all aspects of site characterizations (remedial investigations, closure investigations, surface and groundwater monitoring), including data collection, analytical services, data analysis, and report preparations Primary responsibility for project quality rests with the Rockwell International ER Program Manager Ultimate responsibility for project quality rests with DOE The ER Program Manager will designate a Quality Assurance Officer who will be responsible for QA of field and analytical data

3 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA

The overall quality assurance objective is to implement procedures for field sampling, field testing, chain of custody, laboratory analysis, and reporting that will assure quality as specified in DOE orders governing quality assurance and environmental protection and as required for RCRA groundwater monitoring programs in 40 CFR 264 Subpart F and 265 Subpart F Specific procedures to be used for sampling, chain-of-custody, audits, preventive maintenance, and corrective actions are described in the appropriate sections of this QA/QC Plan and the Standard Operations Procedures (SOPs) (Rockwell International, 1989) The purpose of this section is to define quality assurance goals for accuracy, precision and sensitivity of analysis, and completeness, representativeness, and comparability of measurement data from all analytical laboratories and field measurements

For some field activities, samples will not be collected, but measurements will be taken where quality assurance concerns are appropriate (e g , field measurements of pH, temperature, and elevations) The primary quality assurance objective during field measurement activities is to obtain reproducible measurements to a degree of accuracy consistent with their intended use and to document measurement procedures

3.1. REGULATORY AND LEGAL REQUIREMENTS

Data objectives are to obtain complete, accurate, precise and representative data to use in evaluating groundwater quality at regulated units for RCRA detection and compliance programs (40 CFR Part 264) and RCRA assessment and alternative programs (40 CFR Part 265) Data will also be used in evaluating soil, surface water, and ground-water quality at CERCLA sites/RCRA solid waste management units The State of Colorado Department of Health (CDH) has RCRA regulatory authority over the ground-water protection program for the RCRA regulated units EPA has ultimate authority over the CERCLA site/RCRA solid waste management investigations

Specific RCRA and CERCLA regulatory requirements for quality assurance are identified in 40 CFR Parts 190 to 399 RCRA requirements for ground-water well installation, sample collection, and sample analysis are found in 40 CFR 264 97, 265 91, and 265 92 These requirements are included in the SOPs and this QA/QC Plan For Fund-financed CERCLA sites, sampling must conform to a written quality assurance/site sampling plan [40 CFR 300 68 (k)] Although the Rocky Flats Plant is not a Fund-financed site, the elements of the plan identified in 40 CFR 300 68(k) are included in this QA/QC plan, the SOPs, and the sampling plan for this program These elements are as follows

(i) A description of the objectives of the sampling efforts with regard to both the phase of the sampling and the ultimate use of the data,

(ii) Sufficient specification of sampling protocol and procedures,

(iii) Sufficient sampling to adequately characterize the source of the release, likely transport pathways, and/or potential receptor exposure,

(iv) Specifications of the types, locations, and frequency of samples taken, taking into account the unique properties of the site, including the appropriate hydrological, geological, hydrogeological, physiographical, and meteorological properties of the site

3 2 DATA QUALITY OBJECTIVES

Data Quality Objectives (DQOs) are defined as qualitative and quantitative statements of the quality of data needed to support specific decisions or actions The DQOs for the Rocky Flats ER Program are primarily related to remedial investigations, feasibility studies, remedial action, remedial action performance assessment, and surface water and ground-water monitoring activities

The success of these activities depends on the decisions made, actions taken, and that the quality of the data is compatible with the requirements of the decision-making One measure of success is the extent to which the DQOs for these activities are achieved Establishing useful and attainable DQOs depends on identifying the following elements

- o Data Users (i e, who are the decision-makers and end-users of the data?)
- o Data Uses (i e, what will the data be used for?)
- o Data Types (i e, what data are needed?)
- o Sampling and Analytical Options (i e, what are the available alternatives?)
- o PARCC Parameters* (i e, what levels of data quality are needed to meet PARCC requirements?)

  * PARCC Parameters - Parameters related to Precision, Accuracy, Representativeness, Comparability, and Completeness

Each of these elements is discussed in the sections that follow

3 2.1 Data Users

The data users consist of decision-makers, program management staff, and technical personnel For the RFP ER Program, these users are defined below

DECISION-MAKERS

The principal decision-makers are identified as the Federal officials responsible for RFP operations and the Federal and state regulatory officials responsible for environmental protection

U S Environmental Protection Agency (EPA) Region VIII (Denver)

The EPA-Region VIII group overseeing the Environmental Restoration Program at the RFP is the Waste Management Division The identified decision-makers are the Waste Management Division Director and the RCRA and CERCLA Branch Chiefs

State of Colorado Department of Health (CDH-Denver)

The CDH group overseeing the Environmental Restoration Program at the RFP is the Hazardous Materials and Waste Management (HMWM) Division The identified decision-maker is the HMWM Division Director, the Hazardous Waste Section Leader, and the Unit Leaders of the Hazardous Waste Facilities Unit and the Monitoring and Enforcement Unit

U.S. Department of Energy - Albuquerque Operations Office

The DOE-AL is identified as the owner of the Rocky Flats Plant and the lead Federal agency responsible for operation of the facility The DOE-AL, Environment, Safety, and Health Division, Environmental Restoration Program Branch, is charged with coordinating ER Programs conducted at DOE facilities under its jurisdictions The identified decision-makers are the Division Director and the Manager of the ER Program

U S Department of Energy - Rocky Flats Area Office (RFAO)

The DOE-AL/RFAO group charged with ensuring compliance with environmental regulations at the RFP is the Environmental, Safety and Health Branch The identified decision-maker is the Branch Chief

PROGRAM MANAGEMENT STAFF

The principal program management staff are identified as the prime contractor personnel responsible for the Environmental Restoration Program and ensuring compliance with environmental protection regulations at the RFP Federal Facility

Rockwell International Aerospace Operations/RFP - RCRA/CERCLA Program

The Rockwell RCRA/CERCLA Program office at the RFP has primary responsibility for planning and implementation of the ER Program at RFP The identified data users are the ER Program Manager, the RCRA Closure Program Manager, and the RCRA/CERCLA Program Manager

TECHNICAL PERSONNEL

The principal technical personnel are identified as the Rockwell-RFP technical specialists responsible for supervising, coordinating, and performing ER Program activities

Rockwell International Aerospace Operations/RFP - RCRA/CERCLA Program

Technical Specialists from the Rockwell RFP RCRA/CERCLA Program, other Rockwell groups, and contractors are assigned to coordinate, perform, and supervise sampling, analysis, reporting, and other activities related to the ER Program The identified data users are the Technical Specialists

3.2.2 Data Uses

There are four primary uses of environmental measurement data in the ER Program Environmental data is used for

- Investigation and Characterization
- Risk Assessment
- Evaluation of Remedial Alternatives
- Environmental and RCRA Ground-Water Monitoring

Each of these activities is described below

Investigation and Characterization

Investigation and characterization involves conducting technical studies to investigate and determine the nature and extent of contamination at a site, waste management unit, or operable unit Investigation and characterization activities related to CERCLA/SARA are collectively referred to as Remedial Investigation (RI) activities

Risk Assessment

Risk assessment activities involve examination of the potential risks of identified contaminants to human health and/or the environment Risk assessments involve multi-media modeling of potential exposure routes and environmental pathways for contaminant migration Under CERCLA/SARA, the Hazardous Ranking System (HRS) is used to prioritize sites for inclusion on the National Priorities List (NPL) based on their potential to cause harm to health and/or the environment

Evaluation of Remedial Alternatives

Evaluation of remedial alternatives involves activities related to Feasibility Studies (FS) The FS activities include review and analysis of all Applicable, or Relevant and Appropriate, Requirements (ARARs) related to proposed clean-up remedies ARARs are analyzed to ensure that remedial alternatives will meet Federal and state environmental quality criteria Related FS activities include bench-scale testing and evaluation of costs associated with each remedial alternative

Environmental and RCRA Ground-Water Monitoring

Environmental and RCRA ground-water monitoring involves periodic sampling and analysis of environmental media and ground water at sites and regulated units to determine environmental quality and compliance with relevant regulations

3.2.3 Data Types

There are five classes of environmental measurement data needed to support the RFP ER Program These five classes are

- o Hydrogeologic Data
- o Organic Chemistry
- o Inorganic (Metals) Chemistry
- o Major Ion Chemistry
- o Radiochemistry

Specific measurement data needed for each of the five classes is described below

Hydrogeologic Data

Hydrogeologic data is needed primarily for determining geologic and hydrologic characteristics of the RFP site and specific site areas under investigation

Geologic data is obtained from geologic mapping, drilling, and geophysical logging activities Hydrologic data is obtained from hydrologic mapping, well installation, well completion, and surface water measurement activities Data collected during these activities are recorded in logging formats prescribed in subcontractor technical specification documents such as the Work Plans and Standard Operating Procedures (SOPs)

Ground-water samples need to be collected quarterly from monitoring wells Samples are collected and maintained under chain-of-custody Groundwater monitoring activities require collection and documentation of the following data during sampling

- Well numbers and locations
- Dates & Times Sampled
- Water Levels and Volumes
- Field Measurements
- Water Temperatures
- pH
- Specific Conductance
- Water Descriptions
- Weather Conditions
- Sample Transfers to Laboratory (Dates/Times)
- Comments/Observations During Sampling
- Samples Collected
- Parameters Collected
- Preservatives Used/ Filtering (Y/N)
- Sampling Methods
- Equipment Numbers Used
- Trip Blanks and Field Blanks Used Sources of Trip and Field Blanks

Organic Chemistry

Organic chemistry data needs consist of the compounds on EPA's Contract Laboratory Program (CLP) Target Compounds List (TCL) Analyses for TCL organics are essential because some of these compounds have been identified in ground water, surface water, and soil samples collected during Phase I remedial investigation studies These analyses are needed for comparison of CERCLA site and RCRA closure unit data with ARARs The quantitation limits needed are specified in Table 3-7 As shown in Table 3-1, it is noted that in some instances CLP quantita-

TABLE 3-1

COMPARISON OF CHEMICAL-SPECIFIC ARARS AND TBCs TO ANALYTICAL DETECTION LIMITS

ANALYTE	ARAR OR TBC	CITATION	DETECTION LIMIT
Copper	0 2 mg/l	5CCR 1002-8, Sec 3 11 5	025 mg/l
Iron	0 3 mg/l	5CCR 1002-8, Sec 3 11 5	1 mg/l
Manganese	0 05 mg/l	5CCR 1002-8, Sec 3 11 5	015 mg/l
Mercury	0 002 mg/l	5CCR 1002-8, Sec 3 11 5	0002 mg/l
Molybdenum	0 1 mg/l	5CCR 1002-8, Sec 3 11 5	04 mg/l
Nickel	0 2 mg/l	5CCR 1002-8, Sec 3 11 5	04 mg/l
Selenium	0 01 mg/l	SDWA MCL	005 mg/l
Thallium	0 015 mg/l	5CCR 1002-8, Sec 3 1 7	01 mg/l
Zinc	2 0 mg/l	5CCR 1002-8, Sec 3 11 5	02 mg/l
Cobalt	0 05 mg/l	5CCR 1002-8, Sec 3 11 5	05 mg/l
Vanadium	0 1 mg/l	5CCR 1002-8, Sec. 3 11 5	05 mg/l
Carbon Tetrachloride	5 ug/l	SDWA MCL	5 ug/l
1,1-Dichloro-ethene	7 ug/l	SDWA MCL	5 ug/l
Chloroform	100 ug/l	SDWA MCL	5 ug/l
1,2-Dichloro-ethane	5 ug/l	SDWA MCL	5 ug/l

TABLE 3-1
COMPARISON OF CHEMICAL-SPECIFIC ARARS AND TBCs TO ANALYTICAL DETECTION LIMITS (CONTINUED)

ANALYTE	ARAR OR TBC	CITATION	DETECTION LIMIT
t-1,2-Dichloro-ethene	0 03 ug/l	5CCR 1002-8, Sec 3 11 5 (proposed std)	5 ug/l*
Methylene Chloride	5 ug/l	EPA DW Health Advisory	5 ug/l
Tetrachloro-ethene	0 8 ug/l	5CCR 1002-8, Sec 3 11 5 (proposed std)	5 ug/l*
1,1,1-Tri-chloroethane	200 ug/l	SDWA MCL	5 ug/l
Trichloroethene	5 ug/l	SDWA MCL	5 ug/l
Vinyl Chloride	2 ug/l	SDWA MCL	10 ug/l*
Gross Alpha	15 pCi/l	SDWA MCL	2 pCi/l
Gross Beta	50 pCi/l	SDWA MCL	4 pCi/l
$Pu^{238,239,240}$	15 pCi/l	5CCR 1002-8, Sec 3 11 5 51FR 34859 (proposed std)	01 pCi/l
$Americium^{241}$	4 pCi/l	51FR 34859 (proposed std)	01 pCi/l
$Strontium^{90}$	8 pCi/l	5CCR 1002-8, Sec 3 11 5	1 pCi/l
$Uranium^{total}$	40 pCi/l	5CCR 1002-8, Sec 3 8 5(3)	6 pCi/l
Chloride	250 mg/l	5CCR 1002-8, Sec 3 11 5	5 mg/l
Sulfate	250 mg/l	5CCR 1002-8, Sec 3 11 5	5 mg/l
Total Dissolved Solids	400 mg/l	5CCR 1002-8, Sec 3 11 5(B)(4)	5 mg/l

* Detection limit exceeds TBC
TBC = to be considered

tion limits are above ARARs (t-1,2-dichloroethene, tetrachloroethylene, and vinyl chloride) These compounds will be considered not present if not detected at the quantitation limit

Inorganic (Metals) Chemistry

Soil, ground water, and surface water need to be analyzed for the CLP Inorganic Target Analyte List (TAL) In addition to the target analytes, analyses for the following are also needed

- Strontium
- Tin
- Lithium
- Hexavalent Chromium
- Trivalent Chromium

Filtered and unfiltered surface water samples need to be analyzed for metals (TAL metals and five additional metals above) Ground-water samples need to be analyzed for filtered metals only These analyses are necessary to define transport phenomena, to evaluate aquifer continuity, and for comparison with EPA and CDH ARARs Detection limits needed are specified in Table 3-8 As shown in Table 3-1, all metals for which ARARs exist can be detected at levels at or below ARARs

Other Water Quality Parameters

Analyses needed for other water quality parameters include the following

- Bicarbonate
- Carbonate
- Chloride
- Nitrate as N
- Sulfate
- Total Dissolved Solids
- Total Suspended Solids
- Dissolved Oxygen

Ground-water and surface water samples will not be filtered prior to analysis of these parameters Detection limits needed are identified in Tables 3-3 and 3-4 As shown in Table 3-1, major ions for which ARARs exist can be detected at or below the respective ARAR

Major ion analyses are used to define and characterize water quality in ground water and surface waters There are no EPA CLP methods for major ion analyses The EPA SW-846 methods and EPA Methods for the Chemical Analysis of Water and Wastes will be used and adapted as necessary to achieve the above detection limits

Radiochemistry

Radiochemistry analyses are needed for soil, ground water, and surface water samples The following radionuclide analyses are needed

- Plutonium$^{239+240}$
- Americium^{241}
- Uranium$^{233+234}$
- Uranium^{238}
- Uranium^{235}
- Tritium
- Strontium^{90}
- Cesium^{137}
- Gross Alpha
- Gross Beta
- Radium^{226}
- Radium^{228}

All surface water samples need to be analyzed for filtered and unfiltered radionuclides Ground-water samples need to be analyzed for filtered radionuclides only

These analyses are needed for comparison with EPA and CDH ARARs and RFP background data In some cases, the RFP background concentrations are lower than ARAR values Minimum Detectable Activities required to measure background levels and/or compliance with ARARs are shown in Tables 3-5 and 3-6

There are no CLP methods available for conducting these analyses Standard analytical methods for radiochemistry analyses have been selected such that the detection limits in Tables 3-5 and 3-6 are achieved

3.2 4 PARCC Parameters

The PARCC parameters consist of Precision, Accuracy, Representativeness, Comparability, and Completeness The specific objectives associated with each of these parameters are dependent on the intended use(s) of the data Specific objectives are described in sampling and analysis plans prior to initiating any sampling or analysis activities

For the RFP ER Program, environmental data collected must conform to the following criteria

1. Data must be of known and documented quality

2. Data must be obtained in accordance with rigorous, documented, quality assurance/quality control criteria

3. Data may originate from sampling and analysis of non-conventional parameters Radionuclide analyses are examples of non-conventional parameters

4. Data obtained from analyses are characterized by low detection limits and method-specific detection limits Where available, CLP methods and protocols are used Methods and associated detection limits are selected such that data may be compared with Federal and state ARARs and/or RFP background concentration values

5. Data is reviewed and validated independent of the laboratory according to validation procedures prescribed by EPA and DOE (DOE, 1987, EPA, 1988a, EPA, 1988b) Review and validation activities are documented Data is not used until it has been reviewed and its validity determined Data validity in the RFP ER Program has three classifications 1) Valid, 2) Acceptable for Use with Qualification(s), and 3) Rejected (Unacceptable)

Data Quality Objectives

The overall objectives for sampling and analysis include the following

1 To identify and quantify any releases of contaminants into the environment resulting from RFP activities

2 To obtain defensible data of known and documented quality that support monitoring activities and will withstand regulatory scrutiny

3 To review and validate a minimum of 10% of all quarterly ground-water sample data All (100%) of ground-water sample data used in this background characterization will be reviewed and validated

These objectives are formulated in terms of the PARCC requirements described below

Precision and Accuracy

Precision and accuracy are largely dependent on the analysis methods used and the results of duplicate, blank, and spike analyses Generally, only data which meet the validation criteria of (1) valid or (2) acceptable will achieve the necessary level of precision and accuracy needed to achieve the data quality objectives

Some data points from data sets validated as rejected (unacceptable) may be used in rare instances such as storm samples collected under unique occurrences Such data points must be flagged as rejected whenever they are cited

Representativeness

Sample locations and frequency are chosen to assure data is representative of the environmental medium under evaluation

Comparability

Samples are collected using the procedures specified in the SOPs Samples are analyzed for organics (except background), metals, major ions, and radionuclides using the methods, and meeting the detection limits, described in Tables 3-3, 3-4, 3-5, and 3-6

Completeness

Completeness is determined by comparing the amount of usable data obtained to the amount that was expected to be obtained The objective for completeness is to obtain 90% valid or acceptable data

3.3. LEVEL OF QUALITY ASSURANCE EFFORT

Field duplicates, field blanks, and trip blanks will be taken and submitted to the analytical laboratories to provide a means to assess data quality resulting from field sampling Duplicate samples will be analyzed to evaluate variance due to sampling error Field and trip blanks will be analyzed to check for procedural contamination and/or ambient site conditions that result in sample contamination Trip blanks will be analyzed to check for contamination during packaging and shipment Field blanks are attempts to duplicate sampling conditions with clean water When sampling equipment, such as a bailer is used, a field blank is obtained by rinsing water through the sampling equipment and into the sample bottle The actual number of field QA samples taken will be determined by the Quality Assurance Officer Table 3-2 will serve as a guideline for this determination Field QA samples will be designated with a sample number that indicates that they are QA samples so the laboratory will not inadvertently use these samples for spike and duplicate analysis For laboratory analysis, matrix spikes and matrix spike duplicates samples so the laboratory will not inadvertently use these samples for spike and duplicate analysis For laboratory analysis, matrix spikes and matrix spike duplicates are used The general level of quality assurance effort for organic analysis will be one matrix spike and one matrix spike duplicate prepared for every 20 samples of similar concentration and/or similar sample matrix, whichever is greater In addition, water samples of known concentration traceable to either EPA or NBS standards will be prepared for inorganic and radiological analyses The general level of quality assurance effort for inorganic analyses will be one standard sample and one field duplicate sample for every 20 investigative samples to check analytical reproducibility

Soil samples selected for geotechnical testing will include one field duplicate for each 20 analyses being performed, if possible, but will not include blanks

The ground-water, surface water, and soil samples collected at Rocky Flats Plant during the ER Program investigations will be analyzed using the analytical methods specified in Tables 3-3, 3-4, 3-5 and 3-6 The laboratory level quality assurance procedures, blanks, spikes, as well as calibration procedures are specified in each of the referenced methods

3.4. ACCURACY, PRECISION, AND SENSITIVITY OF ANALYSES

The fundamental quality assurance objective with respect to accuracy, precision, and sensitivity of laboratory analytical data is to achieve the quality control acceptance criteria of the analytical protocols Sensitivities required for analyses of radionuclides, organics, metals, and other inorganic compounds, in both aqueous

TABLE 3-2

GUIDELINES FOR QA/QC SAMPLES FOR FIELD SAMPLING PROGRAMS FOR SOILS, SEDIMENTS, AND WATER

Analyte	Duplicates	Field Blank	Trip Blank
TCL Volatiles	1 in 20	1 in 20	1 per day of sampling
TAL inorganics and TCL organics (excluding volatiles)	1 in 20	1 in 20	
Radionuclides	1 in 20	1 in 20	
Other Inorganics	1 in 20		

NOTE: Trip blanks and field blanks will be prepared with distilled/deionized organic free laboratory water for solids and aqueous samples.

TABLE 3-3
ANALYSIS PLAN FOR AQUEOUS SAMPLES[a]

Analyte	Method	Detection Limit	Sample Container	Sample Volume	Preservations	Holding Time (days)	Reporting Units
TCL volatile	EPA SOW[b]	x[e]	40-ml vial (2) w/Teflon-lined silicon rubber septum	40 ml	4°C[j]	14	ug/l
TCL base/neutral/acid[c]	EPA SOW	x[e]	1 liter amber glass	1 l	4°C	7/40[i]	ug/l
TCL pesticide/PCB	EPA SOW	x[e]	1 liter amber glass	1 l	4°C	7/40[i]	ug/l
TAL inorganic	EPA SOW -	x[e]	500 ml plastic	>50 ml[m]	pH<2, w/HNO_3[k]	180	mg/l
Non-TAL metals[d]	EPA 6000 - 7000 series	x[e]	500 ml plastic	0 ml[m]	pH<2, w/HNO_3[k]	180	mg/l
Cyanide	EPA 9010	x[e]	1 liter plastic	0 5 l	pH>12, w/NaOH	14	mg/l
pH[f]	EPA 9840	0 1 pH unit	500 ml plastic	N/A	None	Field meas	pH unit
Specific Conductivity[f]	EPA 9050	1	500-ml plastic	N/A	None	Field meas	umho/cm
Temperature[f]	EPA 9050	0 1	500 ml plastic	N/A	None	Field meas	°C
Dissolved Oxygen[f]	EPA 9050	0 5	500-ml plastic	N/A	None	Field meas	mg/l
TDS	EPA 160 1[j]	5	500-ml plastic	50 ml[l]	4°C	7	mg/l
TSS	EPA 160 2[j]	10	500-ml plastic	100 ml[l]	4°C	7	mg/l
Chloride, sulfate	EPA 9251 EPA 9038	5	500-ml plastic	5 ml, 15 ml[l]	4°C[k]	28	mg/l
Oil & Grease	EPA 9070	5	1 liter amber glass	1 l	pH<2, w/H_2SO_4	28	mg/l

TABLE 3-3 (Continued)
ANALYSIS PLAN FOR AQUEOUS SAMPLES[a]

Analyte	Method	Detection Limit	Sample Container	Sample Volume	Preservations	Holding Time (days)	Reporting Units
Carbonate/bicarbonate[g]	S M 403[h]	10	500 ml plastic	20 ml[l]	4°C[k]	14	mg/l
Nitrate + Nitrite	EPA 353 2	5	100 ml plastic	5 ml	4°C[k], pH<2 w/H_2SO_4	28	mg/l
Hexavalent chromium	S.M 312B[h]	0 01	500-ml plastic	100 ml[l]	4°C[k]	1	mg/l

TCL Target Compound List
TAL Target Analyte List
N/A - not applicable
TDS - total dissolved solids
TSS total suspended solids
[a] The sampling plans will define the actual suite of parameters to be analyzed for specific samples.
[b] EPA, 1987a; EPA, 1987b
[c] The TCL base/neutral/acid fractions analytical parameters are the HSL semivolatiles
[d] Includes cesium, lithium, molybdenum, strontium, and tin which are non-TAL metals.
[e] See Tables 3-7 and 3-8.
[f] Field measurements
[g] These are reported as carbonate and bicarbonate alkalinity.
[h] Standard Methods for Examination of Water and Wastewater, 16th Edition
[i] Extraction within 7 days, analysis within 40 days of extraction
[j] Methods for Chemical Analysis of Water and Wastes, 1983, EPA 600/4 79 020.
[k] Sampling Plan may specify filtered sample Sampling will be done in field within 2 hours of sample collection preservatives added after filtering.
[l] Aliquot for analysis of TDS, TSS, chloride, sulfate, carbonate/bicarbonate, and hexavalent chrome can be drawn from one 500 ml plastic container
[m] Aliquots for analysis of TAL inorganics and non TAL metals can be drawn from one 500 ml plastic container.

TABLE 3-4

ANALYSIS PLAN FOR SOIL/SEDIMENT/WASTE SAMPLES[a]

Analyte	Method	Detection Limit	Sample Container	Sample Amount (g)	Preservations	Holding Time (days)	Reporting Units
TCL volatile	EPA SOW[b]	x[d]	4 ounce glass	5	4°C	14	ug/kg[f]
TCL base/neutral/acid	EPA SOW	x[d]	8 ounce glass	10 30	4°C	7/40	ug/kg[f]
TCL Pesticide/PCB	EPA SOW	x[d]	8-ounce glass	10 30	4°C	7/40[e]	ug/kg[f]
TAL inorganic	EPA SOW	x[d]	8 ounce glass	10 30	4°C	180	mg/kg[f]
Non-TAL metals[c]	EPA 7000 & 6010 series	x[d]	8-ounce glass	10-30	4°C	180	mg/kg[f]
Reactivity	EPA 9010 and 9030	Ref b	8 ounce glass	-	4°C	N/A	ug/l
Chloride	EPA 9251	60 u/g[h]	8-ounce glass	10 20	4°C	N/A	mg/kg[f]
Sulfate	EPA 9038	60 ug/g[h]	8 ounce glass	10 20	4°C	N/A	mg/kg[f]
Nitrate + Nitrite	EPA 353 2[g]	60 ug/g[h]	8-ounce glass	10	4°C	N/A	mg/kg[f]
Cyanide	EPA 9010	x[d]	8 ounce glass	5	4°C	14	mg/kg[f]
Sulfide	EPA 9030	4 ug/g	8 ounce glass	10	4°C	N/A	mg/kg[f]
% Moisture/% Solids	EPA 160 3	10 mg	8 ounce glass	5 10	4°C	N/A	%
Hexavalent chromium	S M 312B[i]	1 ug/g[h]	8-ounce glass	50 250	4°C	1	mg/kg[f]
pH	U S D.A [j]	N/A	8-ounce glass	10	4°C	N/A	pH Units

TABLE 3-4
(Continued)

TCL Target Compound List
TAL - Target Analyte List
N/A not applicable
[a] The sampling plans will define the actual suite of parameters to be analyzed for specific samples
[b] EPA, 1987a, EPA, 1987b
[c] Includes cesium, lithium, molybdenum, strontium, and tin which are non TAL metals
[d] See Tables 3-7 and 3-8.
[e] Extract within 7 days, analysis within 40 days of extraction
[f] Reported as dry weight, percent moisture reported separately.
[g] Soil/sediments will be leached with laboratory reagent water (10 g soil to 50 ml water) and the water extract will be analyzed using procedure in "Methods for Chemical Analysis of Water and Wastes," 1983; EPA 600/4-79-020
[h] These are estimated detection limits
[i] Soil/sediment will be leached with laboratory reagent water (5 g soil and 100 ml of water) by shaking for 2 hours, and the water extract filtered and subsequently analyzed This is in accordance with method 312B in Standard Methods for Examination of Water and Wastewater, 16th Edition
[j] U.S D A Agricultural Handbook #60, Method 21C

TABLE 3-5
PLAN FOR RADIOLOGICAL ANALYSIS OF AQUEOUS SAMPLES

Analyte	Method[a]	Detection Limit[b]	Sample Container	Sample Volume[c]	Preservations	Holding Time (days)	Reporting Units
Gross alpha/beta	1,2,3,4,6, 7,8,9	Gross a = 2 pCi/l Gross b = 4 pCi/l	1-gallon plastic[c]	0 2 l	HNO_3 to pH<2	180	pCi/l
Tritium	1,2,3,8	400 pCi/l	100 ml glass	0 008 l	No preservation	None	pCi/l
Plutonium-239 + 240	10,11	0 01 pCi/l	1 gallon plastic[c]	2 5 l[e]	HNO_3 to pH<2	180	pCi/l
Americium 241	11,12	0 01 pCi/l	1 gallon plastic[c]	2 5 l[e]	HNO_3 to pH<2	180	pCi/l
Isotopic Uranium	1,3,4,7,8,9	U 233,234 = 0.6 pCi/l U 235 = 0 6 pCi/l U 238 = 0 6 pCi/l	1 gallon plastic[c]	0 500 l	HNO_3 to pH<2	180	pCi/l
Strontium 90	1,3,4,8	1 pCi/l	1-gallon plastic[c]	1 000 l[e]	HNO_3 to pH<2	180	pCi/l
Cesium 137	8	1 pCi/l	1-gallon plastic[c]	1 000 l[e]	HNO_3 to pH<2	180[d]	pCi/l
Radium 226	1,2,3,8[d]	0 5 pCi/l	1-gallon plastic	1 000 l	HNO_3 to pH<2	180[d]	pCi/l
Radium 228	1,2,3,8[d]	1 pCi/l	1 gallon plastic	1 000 L	HNO_3 to pH<2	180[d]	pCi/l

NOTE· Parameters for total analyses are presented in the field parameters for dissolved analyses. Parameters for dissolved analyses are first filtered through a 0.45 u membrane filter and then preserved in the field

N/A - not applicable

HNO_3 nitric acid

U - uranium

a See Notes

b See Notes

c - With the exception of tritium, there will be more than sufficient sample volume to analyze all the radionuclides by filling two one gallon containers or equivalent

d If gross alpha >5 pCi/l, analyze for Ra-226; if Ra 226 >3 pCi/l, analyze for Ra-228 Methodology is reference 13

e - Both plutonium and americium can be analyzed from one 2 5 l sample Both strontium and cesium can be analyzed from one 1 l sample

Table 3-5 Continued
Radiological Analysis - Method References
NOTES

1 U S Environmental Protection Agency, 1979, Radiochemical Analytical Procedures for Analysis of Environmental Samples, Report No EMSL-LY-0539-1, Las Vegas, NV, U S Environmental Protection Agency

2 American Public Health Association, American Water Works Association, Water Pollution Control Federation, 1985 Standard Methods for the Examination of Water and Wastewater, 16th ed, Washington, D C, Am Public Health Association

3 U S Environmental Protection Agency, 1976 Interim Radiochemical Methodology for Drinking Water, Report No EPA-600/4-75-008 Cincinnati U S Environmental Protection Agency

4 Harley, J H, ed, 1975, HASL Procedures Manual, HASL-300, Washington, D C, U S Energy Research and Development Administration

5 "Radioassay Procedures for Environmental Samples," 1967, USDHEW, Section 7 2 3

6 "Handbook of Analytical Procedures," USAEC, Grand Junction Lab 1970, page 196

7 "Prescribed Procedures for Measurement of Radioactivity in Drinking Water," EPA-600/4-80-032, August 1980, Environmental Monitoring and Support Laboratory, Office of Research and Development, U S Environmental Protection Agency, Cincinnati, Ohio 45268

8 "Methods for Determination of Radioactive Substances in Water and Fluvial Sediments," U S G S Book 5, Chapter A5, 1977

9 "Acid Dissolution Method for the Analysis of Plutonium in Soil," EPA-600/7-79-081, March 1979, U S EPA Environmental Monitoring and Support Laboratory, Las Vegas, Nevada, 1979

10 "Procedures for the Isolation of Alpha Spectrometrically Pure Plutonium, Uranium, and Americium," by E H Essington and B J Drennon, Los Alamos National Laboratory, a private communication

11 "Isolation of Americium from Urine Samples," RockyFlats Plant, Health, Safety, and Environmental Laboratories

12 "Radioactivity in Drinking Water," EPA 570/9-81-002

Table 3-5 Continued

NOTES
Lower Limits of Detection

The detection limits presented were calculated using the formula in N R C Regulatory Guide 4 14, Appendix Lower Limit of Detection, pg 21, and follow

$$LLD = \frac{4\ 66\ (BKG/DUR)^{1/2}}{(2\ 22)(Eff)(CR)(SR)(e\text{-}xt)(Aliq)}$$

Where

LLD	=	Lower Limit of Detection in pCi per sample unit
BKG	=	Instrument Background in counts per minute (CPM)
Eff	=	Counting efficiency in cpm/disintegration per minute (dpm)
CR	=	Fractional radiochemical yield
SR	=	Fractional radiochemical yield of a known solution
x	=	The radioactive decay constant for the particular radionuclide
t	=	The elapsed time between sample collection and counting
ALIQ	=	Sample Volume
DUR	=	Duration time in minutes

In that LLD is a function of may variables including sample matrix, sample volume, and other factors, the limits presents are only intended as guides to order-of-magnitude sensitivities and, in practice, can easily change by a factor of two or more even for the conditions specified

TABLE 3-6

PLAN FOR RADIOLOGICAL ANALYSIS OF SOILS/SEDIMENTS

Analyte	Method[a]	Detection Limit[b]	Sample Container	Sample Weight (g)	Preservations	Holding Time (days)	Reporting Units
Gross alpha/beta	1,2,3,4,6, 7,8,9	Gross a = 4 pCi/g dry Gross b = 10 pCi/g dry	1 liter glass[c]	0 1	N/A	N/A	pCi/g dry
Plutonium-239 + 240	10,11	0 03 pCi/g dry	1 liter glass[c]	5	N/A	N/A	pCi/g dry
Americium-241	11,12	0 02 pCi/g dry	1 liter glass[c]	5	N/A	N/A	pCi/g dry
Isotopic Uranium	1,3,4,7,8,9	U 233,234 = 0 3 pCi/g dry U 235 = 0 3 pCi/g dry U 238 = 0 3 pCi/g dry	1 liter glass[c]	1	N/A	N/A	pCi/g dry
Strontium 90	1,3,4,8	1 pCi/g dry	1 liter glass [c]	1	N/A	N/A	pCi/g dry
H 3	3	400 pCi/ml moisture	1 liter glass[c]	8 ml moisture	N/A	N/A	pCi/ml moisture
Cesium 137	8	0 1 pCi/g dry	1 liter glass[c]	100	N/A	N/A	pCi/g dry
Radium 226	8	0 5 pCi/g dry	1 liter glass[c]	100	N/A	N/A	pCi/g dry
Radium 228	8	0 5 pCi/g dry	1-liter glass[c]	100	N/A	N/A	pCi/g dry

U Uranium
N/A - not applicable
U - uranium
a - See Notes, Table 3 5
b - See Notes, Table 3 5
c - Aliquots for radiochemical analysis will come from the same container

and solid matrices will be the detection limits shown in Tables 3-5 through 3-8 Achieving these detection limits depends on the sample matrix Highly contaminated samples requiring dilution will have detection limits higher than those listed

The geotechnical and field data will be considered accurate if the quality assurance criteria with respect to equipment, solutions, and calculations are met, and if adherence to appropriate methods can be documented during a systems audit

3.5 COMPLETENESS, REPRESENTATIVENESS AND COMPARABILITY

The laboratories will provide data meeting quality control acceptance criteria as described in the specified method For the Target Compound List (TCL) constituents, these criteria are defined by the Contract Laboratory Program (CLP) Statement of Work (SOW) for organics (EPA, 1987a) and inorganics (EPA, 1987b) Acceptance criteria for surrogate and matrix spike recovery limits are shown in Tables 3-9 and 3-10 Laboratories will provide a case narrative comparing QC results with method control limits

3 6 FIELD MEASUREMENTS

Measurement data will be generated in many field activities These activities may include, but are not limited to, the following

- using geophysical surveys
- documenting time and weather conditions
- locating and determining the elevation of sampling stations
- measuring pH, conductivity, and temperature of groundwater samples

Table 3-7 Target Compound (TCL) and Required Quantitation Limits (RQL)*

Volatiles	CAS Number	Quantitation Limits** Water ug/L	Low Soil/Sediment[a] ug/Kg
1 Chloromethane	74-87-3	10	10
2 Bromomethane	74-83-9	10	10
3 Vinyl Chloride	75-01-4	10	10
4 Chloroethane	75-00-3	10	10
5 Methylene Chloride	75-09-2	5	5
6 Acetone	67-64-1	10	10
7 Carbon Disulfide	75-15-0	5	5
8 1,1-Dichloroethene	75-35-4	5	5
9 1,1-Dichloroethane	75-34-3	5	5
10 1,2-Dichloroethene (total)	540-59-0	5	5
11 Chloroform	67-66-3	5	5
12 1,2-Dichloroethane	107-06-2	5	5
13 2-Butanone	78-93-3	10	10
14 1,1,1-Trichloroethane	71-55-6	5	5
15 Carbon Tetrachloride	56-23-5	5	5
16 Vinyl Acetate	108-05-4	10	10
17 Bromodichloromethane	75-27-4	5	5
18 1,1,2,2-Tetrachloroethane	79-34-5	5	5
19 1,2-Dichloropropane	78-87-5	5	5
20 trans-1,3-Dichloropropene	10061-02-6	5	5
21 Trichloroethene	79-01-6	5	5
22 Dibromochloromethane	124-48-1	5	5
23 1,1,2-Trichloroethane	79-00-5	5	5
24 Benzene	71-43-2	5	5
25 cis-1,3-Dichloropropene	10061-01-5	5	5
26 Bromoform	75-25-2	5	5
27 2-Hexanone	591-78-6	10	10
28 4-Methyl-2-pentanone	108-10-1	10	10
29 Tetrachloroethene	127-18-4	5	5
30 Toluene	108-88-3	5	5
31 Chlorobenzene	108-90-7	5	5
32 Ethyl Benzene	100-41-4	5	5
33 Styrene	100-42-5	5	5
34 Total Xylenes	1330-20-7	5	5

Table 3-7 (Continued)

Semi-Volatiles	CAS Number	Quantitation Limits** Water ug/L	Low Soil/Sediment[b] ug/Kg
35 Phenol	108-95-2	10	330
36 bis(2-Chloroethyl) ether	111-44-4	10	330
37 2-Chlorophenol	95-57-8	10	330
38 1,3-Dichlorobenzene	541-73-1	10	330
39 1,4-Dichlorobenzene	106-46-7	10	330
40 Benzyl Alcohol	100-51-6	10	330
41 1,2-Dichlorobenzene	95-50-1	10	330
42 2-Methylphenol	95-48-7	10	330
43 bis(2-Chloroisopropyl) ether	108-60-1	10	330
44 4-Methylphenol	106-44-5	10	330
45 N-Nitroso-di-n-Dipropylamine	621-64-7	10	330
46 Hexachloroethane	67-72-1	10	330
47 Nitrobenzene	98-95-3	10	330
48 Isophorone	78-59-1	10	330
49 2-Nitrophenol	88-75-5	10	330
50 2,4-Dimethylphenol	105-67-9	10	330
51 Benzoic Acid	65-85-0	50	1600
52 bis(2-Chloroethoxy) methane	111-91-1	10	330
53 2,4-Dichlorophenol	120-83-2	10	330
54 1,2,4-Trichlorobenzene	120-82-1	10	330
55 Naphthalene	91-20-1	10	330
56 4-Chloroaniline	106-47-8	10	330
57 Hexachlorobutadiene	87-68-3	10	330
58 4-Chloro-3-methylphenol (para-chloro-meta-cresol)	59-50-7	10	330
59 2-Methylnaphthalene	91-57-6	10	330
60 Hexachlorocyclopentadiene	77-47-4	10	330
61 2,4,6-Trichlorophenol	88-06-2	10	330
62 2,4,5-Trichlorophenol	95-95-4	50	1600
63 2-Chloronaphthalene	91-58-7	10	330
64 2-Nitroaniline	88-74-4	50	1600
65 Dimethylphthalate	131-11-3	10	330

Table 3-7 (Continued)

Semi-Volatiles	CAS Number	Quantitation Limits** Water ug/L	Low Soil/Sediment[b] ug/Kg
66 Acenaphthylene	208-96-8	10	330
67 3-Nitroaniline	99-09-2	50	1600
68 Acenaphthene	83-32-9	10	330
69 2,4-Dinitrophenol	51-28-5	50	1600
70 4-Nitrophenol	100-02-7	50	1600
71 Dibenzofuran	132-64-9	10	330
72 2,4-Dinitrotoluene	121-14-2	10	330
73 2,6-Dinitrotuluene	606-20-2	10	330
74 Diethylphthalate	84-66-2	10	330
75 4-Chlorophenyl Phenyl ether	7005-72-3	10	330
76 Fluorene	86-73-7	10	330
77 4-Nitroaniline	100-01-6	50	1600
78 4,6-Dinitro-2-methyl-phenol	534-52-1	50	1600
79 N-nitrosodiphenylamine	86-30-6	10	330
80 4-Bromophenyl Phenyl ether	101-55-3	10	330
81 Hexachlorobenzene	118-74-1	10	330
82 Pentachloropphenol	87-86-5	50	1600
83 Phenanthrene	85-01-8	10	330
84 Anthracene	120-12-7	10	330
85 Di-n-butylphthalate	84-74-2	10	330
86 Fluoranthene	206-44-0	10	330
87 Pyrene	129-00-0	10	330
88 Butylbenzylphthalate	85-68-7	10	330
89 3,3'-Dichlorobenzidine	91-94-1	20	660
90 Benzo(a)anthracene	56-55-3	10	330
91 bis(2-ethylhexyl) phthalate	117-81-7	10	330
92 Chrysene	218-01-9	10	330
93 Di-n-octyl Phthalate	117-84-0	10	330
94 Benzo(b)fluoranthene	205-99-2	10	330
95 Benzo(k)fluoranthene	207-08-9	10	330
96 Benzo(a)pyrene	50-32-8	10	330
97 Indeno(1,2,3-cd)pyrene	193-39-5	10	330
98 Dibenz(a,h)anthracene	53-70-3	10	330
99 Benzo(g,h,i)perylene	191-24-2	10	330

Table 3-7 (Continued)

Pesticides/PCBs	CAS Number	Quantitation Limits** Water ug/L	Low Soil/Sediment[c] ug/Kg
100 alpha-BHC	319-84-6	0 05	8 0
101 beta-BHC	319-85-7	0 05	8 0
102 delta-BHC	319-86-8	0 05	8 0
103 gamma-BHC (Lindane)	58-89-9	0 05	8 0
104 Heptachlor	76-44-8	0 05	8 0
105 Aldrin	309-00-2	0 05	8 0
106 Heptachlor Epoxide	1024-57-3	0 05	8 0
107 Endosulfan I	959-98-8	0 05	8 0
108 Dieldrin	60-57-1	0 10	16 0
109 4,4'-DDE	72-55-9	0 10	16 0
110 Endrin	72-20-8	0 10	16 0
111 Endosulfan II	33213-65-9	0 10	16 0
112 4,4'-DDD	72-54-8	0 10	16 0
113 Endosulfan Sulfate	1031-07-8	0 10	16 0
114 4,4-'DDT	50-29-3	0 10	16 0
115 Endrin Ketone	53494-70-5	0 10	16 0
116 Methoxychlor	72-43-5	0 5	80 0
117 alpha-Chlordane	5103-71-9	0 5	80 0
118 gamma-Chlordane	5103-74-2	0 5	80 0
119 Toxaphene	8001-35-2	1 0	160 0
120 AROCLOR-1016	12674-11-2	0 5	80 0
121 AROCLOR-1221	11104-28-2	0 5	80 0
122 AROCLOR-1232	11141-16-5	0 5	80 0
123 AROCLOR-1242	53469-21-9	0 5	80 0
124 AROCLOR-1248	12672-29-6	0 5	80 0
125 AROCLOR-1254	11097-69-1	1 0	160 0
126 AROCLOR-1260	11096-82-5	1 0	160 0

[a] Medium Soil/Sediment Required Quantitation Limits (RQL) for Volatile TCL Compounds are 125 times the individual Low Soil/Sediment RQL

[b] Medium Soil/Sediment Required Quantitation Limits (RQL) for Semi-Volatile TCL Compounds are 60 times the individual Low Soil/Sediment RDL.

[c] Medium Soil/Sediment Required Quantitation Limits (RQL) for Pesticide TCL compounds are 15 times the individual Low Soil/Sediment RQL.

*These are the EPA quantitation limits under the Contract Laboratory Program Specific quantitation limits are highly matrix dependent The quantitation limits listed herein are provided for guidance and may not always be achievable

**Quantitation limits listed for soil/sediment are based on wet weight The quantitation limits calculated by the laboratory for soil/sediment, calculated on dry weight basis, as required by the contract, will be higher

TABLE 3-8

NOMINAL DETECTION LIMITS FOR TAL METALS AND OTHER INORGANICS

Element	Nominal Detection Limit[1,2] Water (ug/l)	Soil (mg/kg)
Aluminum	200	40
Antimony	60	12
Arsenic	10	2
Barium	200	40
Beryllium	5	1 0
Cadmium	5	1 0
Calcium	5000	2000
Chromium	10	2 0
Cobalt	50	10
Copper	25	5 0
Iron	100	20
Lead	5	1 0
Magnesium	5000	2000
Manganese	15	3 0
Mercury	0 2	0 2
Nickel	40	8.0
Potassium	5000	2000
Selenium	5	1 0
Silver	10	2 0
Sodium	5000	2000
Thallium	10	2 0
Vanadium	50	10 0
Zinc	20	4 0
Cyanide	10	10
Cesium[3]	1000	200
Chromium (VI)[3]	10	1
Lithium[3]	100	20
Molybdenum[3]	200	40
Strontium[3]	200	40
Tin[3]	200	40

TABLE 3-8
(continued)

[1]Higher detection levels may also be used in the following circumstances

> If the sample concentration exceeds two times the detection limit of the instrument or method in use, the value may be reported even though the instrument or method detection limit may not equal the nominal detection limit This is illustrated in the example below
>
> For lead
>
> > Method in use ICP
> > Instrument Detection Limit (IDL) = 40
> > Sample Concentration = 85
> > Contract Required Detection Limit (CRDL) = 5
>
> The value of 85 may be reported even though instrument detection limit is greater than nominal detection level The instrument or method detection limit must be documented

[2]The given detection limits are the instrument detection limits obtained in pure water using the procedures given in Tables 3-3 and 3 4 The detection limits for samples may be considerably higher depending on the sample matrix.

[3]These are non-CLP Target Analytes

TABLE 3-9

QUALITY ASSURANCE OBJECTIVES OF ACCURACY FOR ORGANIC SURROGATE ANALYSES[a]

Fraction	Surrogate Compound	Recovery Limits Low/Medium Water	Low/Medium Soil/Sediment
VOA	Toluene-d8	88-100	81-117
VOA	4 Bromofluorobenzene	86-115	74-121
VOA	1,2-Dichloroethane-d4	76-114	70-121
BNA	Nitrobenzene-d5	35-114	23-120
BNA	2 Fluorobiphenyl	43-116	30-115
BNA	p-Terphenyl-d14	33 114	18-137
BNA	Phenol-d5	10 94	24-113
BNA	2-Fluorophenol	21 100	25-121
BNA	2,4,6-Tribromophenol	10 123	19-122
Pesticides	Dibutylchlorendate	24 154[b]	20-150[b]

VOA Volatile organics analysis
BNA - Base/neutral, acid

a US EPA SOW 10/86 as revised 8/87
b These recoveries are advisory only

TABLE 3-10

QUALITY ASSURANCE OBJECTIVES OF ACCURACY AND PRECISION OF ORGANIC TARGET COMPOUND LIST ANALYSES[a]

Fraction	Matrix Spike Compound	Recovery Limits Water	Recovery Limits Soil/Sed	% RPD Limits Water	% RPD Limits Soil/Sed
VOA	1,1Dichloroethene	61-145	59-172	14	22
VOA	Trichloroethene	71-120	62-137	14	24
VOA	Chlorobenzene	75-130	60-133	13	21
VOA	Toluene	76-125	59-139	13	21
VOA	Benzene	76-127	66-142	11	21
BN	1,2,4 Trichlorobenzene	39-98	38-107	29	23
BN	Acenaphthene	46-118	31-137	31	19
BN	2,4-Dinitroroluene	24-96	28-89	38	47
BN	Pyrene	26-127	35-142	31	36
BN	N-nitroso-di-n-propylamine	41-116	41-126	38	38
BN	1,4-Dichlorobenzene	36-97	28-104	28	27
Acid	Pentachlorophenol	9-103	17-109	50	47
Acid	Phenol	12-189	26-90	42	35
Acid	2-Chlorophenol	27-123	25-102	40	50
Acid	4-Chloro-3-methol phenol	23-97	26-103	40	50
Acid	4-Nitrophenol	10-80	11-114	50	50
Pest.	Lindane	56-123	46-127	15	50
Pest	Heptachlor	40-131	35-130	20	31
Pest	Aldrin	40-120	34-132	22	43
Pest.	Dieldrin	56-126	31-134	18	38
Pest	Endrin	56-121	42-139	21	45
Pest	4,4-DDT	38-127	23-134	27	50
PCB	Arochlor 1254	Not Established		30	50

[a] US EPA SOW 10/86 as revised 8/87
RPD Relative percent difference
VOA Volatile organic analysis
BNA Base/neutral, acid
Acid - Acid
Pest Pesticide

- qualitative organic vapor screening of solid samples using a photoionization detector (PID) or an organic vapor analyzer (OVA)

- measuring water levels in a borehole or well

- standard penetration testing

- calculating pumping rates

- measuring well-development and presampling purge volumes

- conductivity tests

The general quality assurance objective for such measurement data is to obtain reproducible and comparable measurements to a degree of accuracy consistent with the intended use of the data through the documented use of standardized procedures Procedures for performing these activities and standardized formats for documenting them are presented in other sections of this document These procedures may be incorporated by reference (EPA methods) or included as appendices Standardized formats for documenting data collection are specified in the sampling plans

4. CALIBRATION PROCEDURES AND FREQUENCY

Calibration of equipment used to perform geotechnical testing will be in accordance with that specified in the ASTM Method D 422-63 for hydrometer and sieve analyses (Annual Book of ASTM Standards, Volume 04 08, 1984) The equipment calibrations, including those for ovens, thermometers and balances, shall be done at a minimum of every six months and prior to large scale testing

A calibration log book will be assigned to each field instrument, and all calibrations will be documented in the log books Calibrations of field instruments during sampling will be logged in the field notebook Laboratory calibration of field instruments will be performed at a minimum of every six months and logged in the equipment maintenance logbook In general, calibration procedures will follow the instructions given by the manufacturer The instrument's manual will be available to the operator

5. DATA REDUCTION, VALIDATION, AND REPORTING

Analytical laboratories will provide results to the Rockwell International ER Program Manager, the Subcontractor Project Manager, and Quality Assurance Officers These data will include results for laboratory blanks and duplicates, matrix spikes, and calibration check standards as required by specified analytical methods

Analytical data, including quality control sample analysis, will be entered into the technical data base The analyses will be grouped into lots, with quality control samples associated with a particular lot The analyses of quality control samples will be compared to theoretical known concentrations of those samples If analyses do not meet acceptance criteria, the analytical laboratory may be asked to re-analyze the samples Analyses which cannot meet acceptance criteria, will be labeled as unacceptable All parameter-specific values for a lot in which the quality control analyses did not meet acceptance criteria, will be flagged as such

Analytical reports from a field laboratory, if used, and the geotechnical laboratory will include all raw data, documentation of reduction methods, and related quality assurance/quality control data These data will be assessed by verification of reduction results and confirmation of compliance with quality assurance/quality control requirements

Raw data from field measurements and sample collection activities used in project reports will be appropriately identified Where data have been reduced or summarized, the method of reduction will be documented

The Quality Assurance Officers will review results of Quality Control-acceptance evaluations and will document acceptance or non-acceptance of data The Quality Assurance Officers will maintain records of quality control-acceptance tests These records will be subject to independent audit, which may include Los Alamos National Laboratory

Data will be reviewed and validated by ER Program QA Staff Results of data review and validation activities are documented in data validation reports U S EPA data validation functional guidelines are used for validating organic and inorganic (metals) data Validation methods for radiochemistry and "major ion" data have not been published by EPA, however, data and documentation requirements have been established by ER Program QA staff Data validation methods for these data are derived from these requirements

Three classes of data validity are used in the ER Program (1) V--Valid, (2) A-Acceptable for Use With Qualification(s), and (3) R--Rejected (unacceptable) Analytical results are coded with the appropriate data qualifier (V, A, or R) based on the results of data reviews

Data review and validation is resource-intensive in terms of work time and documentation requirements The following data validation strategy seeks to strike a balance between reviewing and validating all ER Program data and the resources available for conducting this task Data is reviewed according to the needs listed in Table 5-1

Data review and validation activities will be performed concurrently with quarterly on-site audits of RFP and subcontractor laboratories On-site audits and data review activities are conducted by ER Program QA Staff

TABLE 5-1

DATA REVIEW AND VALIDATION NEEDS

	Data Source	Data Type[1]	Review or Validation Need
1	Site Background Samples	I,R,M	100%
2	Surface Water Samples	O,I,R,M	100%
3	RCRA Groundwater Monitoring Samples (Quarterly)	O,I,R,M	10% + Special Request
4	Soil Samples	O,I,R	10%
5	CERCLA Groundwater Monitoring Samples	O,I,R,M	100% First Two Quarters 10% Thereafter and Special Request

[1] O = Organics
I = Inorganics
R = Radionuclides
M = Major Ions

6 INTERNAL QUALITY CONTROL PROCEDURES

Internal quality control procedures for the laboratory are those specified in this QA/QC Plan These specifications include types of audits required (e g, sample spikes, surrogate spikes, reference samples, controls, and blanks), frequency of audits, compounds to be used for sample spikes and surrogate spikes, quality control charts, quality control acceptance criteria for audits, instrument maintenance procedures, and participation in national laboratory comparison programs

The quality control checks and acceptance criteria for data from a field laboratory, if used, and the geotechnical laboratory are described in Sections 3 2, 3 3, 4 0, and 5 0 Quality control procedures for field measurements (pH, conductivity, and temperature) include checking the reproducibility of the measurement in the field by obtaining field duplicates, comparison with laboratory results, multiple readings and/or by calibrating the instruments (where appropriate) Quality control of field sampling will involve collecting field duplicates and field blanks

7. PERFORMANCE AND SYSTEMS AUDITS

For each activity where samples are collected, performance audits investigating conformance with quality control procedures will be conducted at the discretion of the Rockwell International ER Program Manager, Subcontractor Project Manager, and Quality Assurance Officers These audits will be scheduled to allow oversight of as many different field activities as possible Audits will be performed by the Quality Assurance Officers or their designees Written reports along with notices of nonconformity (if necessary), will be submitted to the following individuals

- Rockwell International ER Program Manager
- Subcontractor Project Manager
- Subcontractor Site Manager

At least one systems audit will be performed per year The audit will verify that a system of quality control measures, procedures, reviews, and approvals was established for all activities and is being used by project personnel It will also verify that the system for project documentation is being used and that all quality control records, along with required quality control reviews, approvals, and activity records are being maintained A standard checklist for systems audits will be used The systems audit will be conducted by the Quality Assurance Officers and/or Los Alamos National Laboratory A final report will be prepared which summarizes any deviations from approved methods and their impact on the project results

After consultation with the ER Program Manager (and Subcontractor Project Manager), the Quality Assurance Officers will schedule quarterly systems audits of the participating laboratories and conduct on-site data review At a minimum, the

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After consultation with the ER Program Manager (and Subcontractor Project Manager), the Quality Assurance Officers will schedule quarterly systems audits of the participating laboratories and conduct on-site data review At a minimum, the systems audit will include inspection of laboratory notebooks, control sheets, logsheets, computer files, and equipment calibration and maintenance records

Performance and systems audits of analytical laboratories and on-site data review activities will be scheduled and executed by the laboratory Quality Assurance Officers

8. PREVENTIVE MAINTENANCE

This section applies primarily to field equipment Preventive maintenance will be addressed by checks of field equipment prior to initiation of field operations, to allow time for replacement of malfunctioning equipment For each instrument, the Subcontractor Site Manager will be responsible for implementing and documenting these procedures on a weekly basis during the period of use Manufacturer's instructions will be followed

Preventive maintenance programs for laboratory instruments are addressed in that laboratory's Quality Assurance Program

9 INTERNAL LABORATORY DATA ASSESSMENT PROCEDURES

Analytical data from laboratories is assessed for accuracy, precision and completeness by the laboratory Quality Assurance Officers, using the standard procedures described below

Assessment of data generated by analytical laboratories is initiated and continued at three administrative levels The analyst directly responsible for the test knows current operating acceptance limits He/she can directly accept or reject generated data and consult with his/her immediate supervisor for any corrective action Once the analyst has reported the data as acceptable, he/she initials the report sheet Any out-of-control results are flagged and a note is made as to why the results were reported

The chemist receives the data sheets and reviews the quality control data that accompanied the sample run After checking the reported data for completeness and quality control results, the chemist either initials the report sheet or sends it back to the analyst for rerunning of samples The Quality Control Coordinator reviews data forwarded to him/her as acceptable by the chemist Any remaining out-of-control results that, in the opinion of the Quality Control Coordinator, do not necessitate re-running of the sample, are flagged, and a memo is written to the data user regarding utility of the data Data generated from all analyses are given a final review by the laboratory Quality Assurance Officers

10. CORRECTIVE ACTION PROCEDURES

The Quality Assurance Officer and the designated audit teams will prepare a report describing the results of the performance and/or system audits If unacceptable conditions (e g, failure to have/use procedures), unacceptable data, nonconformity with the quality control procedures, or a deficiency are identified, the Quality Assurance Officers will notify the Rockwell International ER Program Manager of the results of the audit in writing They will also state if the nonconformity is of significance for the program and recommend appropriate corrective actions The Rockwell International ER Program Manager will be responsible for ensuring that a corrective action plan is developed and initiated and that, if necessary, special expertise not normally available to the project team is made available The subcontractor will be responsible for carrying out corrective actions The subcontractor will also ensure that additional work is not performed until the nonconformity is corrected Corrective action may include

- reanalyzing the samples if holding time permits,
- resampling and reanalyzing,
- evaluating and amending the sampling and analytical procedures, and
- accepting the data and acknowledging its level of uncertainty

The Rockwell International ER Program Manager will be responsible for ensuring that corrective action was taken, and that it adequately addressed the nonconformity

After corrective action is taken, the Quality Assurance Officer responsible for the audit will document its completion in a written report The report will indicate any identified findings, corrective action taken, follow-up action, and final recommendations The report will be sent to the Rockwell International ER Program Manager Project staff will be responsible for initiating reports on suspected nonconformities in field activities and deliverables or documents

11. QUALITY ASSURANCE REPORTS

The Rockwell International ER Program Manager will rely on written reports/memoranda documenting data assessment activities, performance and systems audits, nonconformity notices, corrective action reports, and quality assurance notices to enforce quality assurance requirements The Quality Assurance Officer will issue an annual quality assurance report

Records will be maintained to provide evidence of quality assurance activities Proper maintenance of quality assurance records is essential to provide support for legal proceedings and to assure overall quality of the investigation A quality assurance records index will be started at the beginning of the project All information received from outside sources or developed during the project will be retained by the project team Upon termination of an individual task or work assignment, working files will be processed for storage as quality assurance records Upon termination of the program, complete documentation records (for example, chromatograms, spectra, and calibration records) will be archived as required by DOE Order 1324 2A (Records Deposition) The Rockwell International ER Program Quality Assurance Officer and the Los Alamos National Laboratory Quality Assurance Officer will be responsible for ensuring that the Quality Assurance records are being properly stored and that they can be retrieved

12. REFERENCES

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